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FOOD USES FOR SOYBEAN PROTEIN[1]

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The introduction of soybeans into this country has given us an exceedingly versatile crop. It is more easily grown and harvested than most crops. It is at once an oil producer and a protein concentrate. Soybean oil meal and the various grades of protein derived from it enter into food and industrial uses. It is our No. 1 protein concentrate for stock feed mixtures.

We all know of the dependence of Oriental people on the soybean as a source of protein in their diet. As the population of a country increases beyond a certain density, as in China, Japan, and the East Indies, the unfavorable ratio of arable land to population forces a dietary shift away from protein derived from animal sources to that derived from vegetables.

The extensive use of the soybean by Oriental people has led us to believe that we can use it likewise as an economical source of food protein. Serious efforts to use soybean protein in our diet, as well providing it to our World War II allies, dates from the beginning of the food shortage created by the war. The sudden desire at that time to turn soybean protein into food products caught our food technologists unprepared for the job. There was no backlog of technological information which could be used to make the conversion immediately practical and on a large scale.

Hasty projects were set up by interested groups with the idea of quickly breaking through our technical difficulties to successful utilization. Briefly, the results of these efforts were much less than we had hoped.

In summarizing our present position regarding the use of soybean protein in our diet, we can show that it is a highly nutritious protein and the most cheaply produced of any. But we are having difficulty in showing our people how to use it satisfactorily. To state the difficulty another way, our people have well-established food habits which do not include the use of soybeans. Our epicurean customs, developed over the years, are directly related to the agriculture of our country. It is not easy to change them. When new foods are added to a people's diet it must be done with no more than very minor alterations in the customary methods of food preparation in the kitchen, and without bringing too strange a flavor to the table. The best approach to this problem will be to prepare soybeans so that the consumer hardly will be aware that he is eating them. A solution to this problem is not insurmountable but we anticipate that progress will be slow.

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I believe that the greatest inspiration for directing our energies to food uses of soybeans comes from the high nutritional value of the protein.

Perhaps the most logical place to start is its use in combination with wheat flour for bread, spaghetti, vermicelli, doughnuts, griddle cakes, crackers, and other pastry products. In these applications it does a good job of supplementing the nutritional value of the wheat protein without altering food habits.

In 1900 the per capita consumption of wheat flour was 225 pounds, at present it is 154 pounds. Even at this lower level of consumption, wheat flour plays an important part in feeding our population. It appears to me that enrichment of patent wheat flour with a complementary protein is as important to our food program as the practice recently adopted by the wheat milling industry for enriching bread with vitamins.

The work of the Northern Regional Research Laboratory has been occupied more with the basic properties of soybean food products than with the preparation of soybean dishes for the table. However, when time permits, we take an excursion into the culinary arts and try our hand at baking a crock full of soybeans or preparing a bowl of soybean soup and other dishes.

Some of our projects reveal information and develop new products which are useful in both industrial applications and food uses. In working on basic problems there is no sharp line between the two types of investigation. Our alcohol extraction process is such a project. The solution of the problem of alcohol extraction was undertaken because it improved the flavor and color of the flakes for the production of soy flour and at the same time improved the color of the isolated protein for industrial applications.

Continued investigations of the alcohol-extracted flakes has led to our discovery of other useful products. We found that the water extract of the alcohol-extracted flakes could be whipped into a product similar to that obtained by whipping egg whites. It was discovered also that the dissolved material in this water solution had special adhesive properties.

Whipping agents made from soybeans are not new; several companies are marketing such a product derived from crudely isolated protein.

Their products find special application in confectionary manufacture for making nougat cremes, frappes, and mazettas. In these applications, it is used at a low concentration to increase the volume of the whipped product. In making the commercial whip an enzymatic hydrolytic treatment is an important step in the development of maximum foam volume.

The whipping agent derived from the alcohol-extracted flakes as now produced has had no enzymatic treatment, therefore, it has properties different from the hexane-derived products now on the market, and should find other fields of application. The alcohol-derived product has none of the beany flavor so often associated with soybean products nor the bitter taste, which is invariably developed in the enzymatic hydrolysis of proteins. Its bland flavor makes its use possible at a relatively high proportion in a food without deleterious effect on the taste of the product. On heating a solution containing about 5 percent protein or more, the alcohol-extracted product has the property of forming an irreversible gel and again is different from the hexane product in this respect. It is visualized that this important gelatinizing property may lead to the development of such food products as marshmallows. There is the likelihood also that it can be used as a filler for cookies, as an adjunct for making ice cream, for pudding-type desserts, and for other food products. It appears that probably the whipped product can be used also as a meringue for pastry goods. In this application it does not form a hollow shell when oven baked as so frequently happens with egg white. We have not had time to evaluate its use for all of these products but we are highly hopeful that it will find application in most if not all of them.

Soygel

The water-soluble material derived from the alcohol-extracted flakes, which for convenience I shall refer to as "soygel", not only whips like egg white but resembles egg white in that it makes a good glue and will coagulate or become insoluble when heated near the boiling point of water.

The adhesive and coagulation properties have been investigated as a special adhesive for sealing the cork into the crown type of bottle cap. The results were very satisfactory and several companies who manufacture crown seals have tried the adhesive in their production processes. The results of these tests have led them to request its manufacture. Since alcohol-extracted meal is not yet in commercial production, we have made further processing studies to solve the problem of obtaining the soygel from available material. Dr. Beckel of this Laboratory discovered that if hexane-extracted flakes are washed with ethanol, a gel-inhibiting substance is removed and the flakes can then be used for making the soygel. A small-scale plant is now under construction by one soybean processor for washing commercially-extracted flakes with alcohol. These flakes will then be extracted with water and the final product will appear as a spray-dried powder. The adhesive properties of the soygel have been only partly surveyed. It adheres well to glass and tin as well as to wood and paper. These properties, which are different from those of other vegetable protein glues, should make it adaptable for a variety of adhesive applications.

Soybean Varieties:

It is well known that the so-called vegetable or garden varieties of soybeans have better edible qualities than the field type. But growing them on a large scale has been held back by the tendency of the seed to shatter as the pods approach maturity. Everyone is familiar also with certain differences between field varieties, such as color of seed coat, size of bean, and compositional differences in oil, protein, sugars, and salts, but we know very little about the variations in the minor constituents of the soybean, or their edible qualities, or the color and other properties of protein isolated from them. I believe that I am correct in saying that the Chinese select certain beans for edible uses. We have made a preliminary survey to estimate the differences existing in field varieties of soybeans in respect to their edible characteristics. We are examining the cooked whole beans for flavor, appearance, texture, and the time required for satisfactory cooking of the beans for the table. Other important comparisons are to be made on the color and the taste of the solvent-extracted flakes and on the properties of the isolated proteins. The results are not yet ready for a formal report, but we can say definitely that substantial differences in the properties I have mentioned exist. Our results lead us to believe that by using the most suitable processing methods for improving flavor and color, combined with selection of the most desirable types of beans for edible purposes, a remarkable improvement in the quality of the finished products will be made.

There are a number of other soybean food products which have the possibility of broad utilization in this country. Their development and use should be encouraged by the soybean industry. I should like to mention a few of these products rather briefly.

Canned or frozen packed green beans are "good eating" and rich in energy. They can be harvested and handled like green peas. Sprouted soybeans can be used in salads or fried in fat; when properly fried they are a very rich food and have a delicious flavor. Also, they are very promising as a basic ingredient for canned soups. Soy flour can be combined with milk curd to make good cheddar cheese. In the Orient bean curd in various stages of fermentation is the most popular method of using soybeans. Many persons have reported favorably on the flavor of this fermented curd and although it is strange to our diet there are reasons to believe that a scientifically prepared product properly presented to the public would find wide acceptance. A vegetable milk from soybeans is now produced and sold in this country; with some improvement in the taste of soy milk we should expect considerable expansion in its use.